

Review of the manuscript egusphere-2022-96 : “Inter-annual global carbon cycle variations linked to atmospheric circulation variability” by Na Li, Sebastian Sippel, Alexander J. Winkler, Miguel D. Mahecha, Markus Reichstein and Ana Bastos

The authors are investigating the ability of SLP anomaly field to predict global carbon inter-annual variability (IAV) when used in a ridge regression (RR). In particular, the IAV of de-trended global observed atmospheric CO₂ growth rates and modelled global land sink are reconstructed. This RR is compared to a another RR taking 15 teleconnection indices as predictors and to a linear regression only based on SOI. The use of SLP allows a good reconstruction of the different carbon cycle time-series IAV.

In general, the article is a bit difficult to follow. Indeed, the word 'global' is mentioned several times throughout the paper but its meaning is different whether it is CO₂ (single global value) or SLP (800 grid-point). An effort should be made to ease the reading. This paper is showing some potential. However, the paper needs some clarification/modification before publication.

Major comments :

A About the estimation procedure : what is the influence of the LOO consisting in using three consecutive years as test sample ? What would happen if the test sample is bigger ?

B About the SLP anomaly fields as predictors : predictor number evolve from 4 to 800 depending the predictors domain. How ever it seems impractical to perform multiple RR with up to 800 predictors to estimate one global value and select the best predictor domain. If the intend of the authors is to provide an alternative to study the relationship between C-cycle and circulation variability this can be perceived as heavy. Besides, based on Figure 2, the SLP-based RR is not necessarily better than the indices-based RR or the SOI-based linear regression. A user would be tempted to use one of those.

(a) The main problem is to compare results of regression with very different number of predictors only based on ρ_{SLP} . What is the trade-off between adding predictors and the RR improvement ? Since the objective is to capture the IAV, using the principal mode of variability of SLP fields instead of the entire fields could remedy the aforementioned issue. For instance, the first EOFs of SLP fields can be used as predictors. The number of EOF can be chosen according the proportion of the variance captured by the EOFs.

(b) RR is adapted for large numbers of predictors. It would be interesting to see the performances of a usual generalised linear model based on the EOFs of SLP fields.

Minor comments :

— line 29 : 'plagued' may be a little harsh

— line 42 : Replace 'These dynamics' by 'These climate variability modes'. These variability modes may be subject to irreducible noise but they can not be considered as "noise", please rephrase this.

— line 68 : In "while at the same time", at the same is redundant.

— Section Data pre-treatment : clarify this section as follows : 1) trend removing (CO₂, SLP and indices) and anomalies computing (SLP) 2) spatial and temporal aggregation.

— from line 300 : scale is used to refer to the spatial predictor domain or temporal learning periods. Please be precise, in those case scale is not appropriate.

— line 328 : Maybe 2001 instead 2003 ?